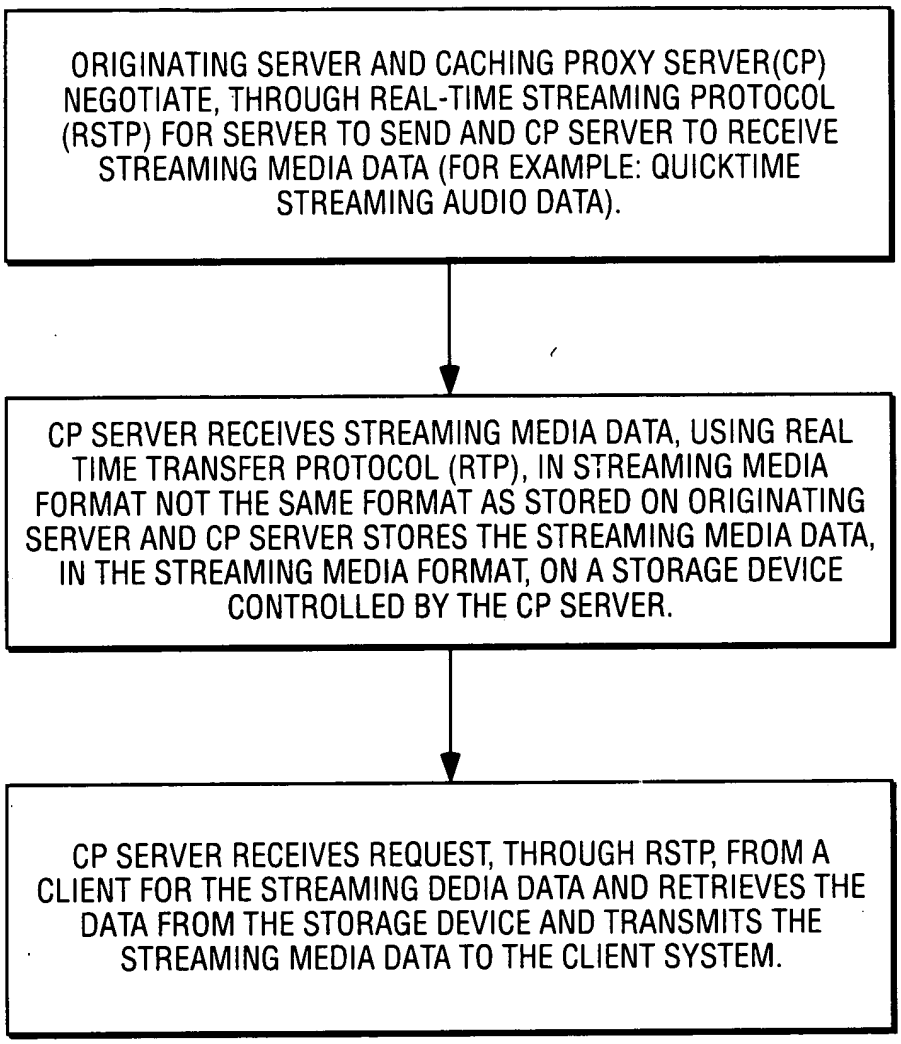
ORIGINATING SERVER AND CACHING PROXY SERVER(CP) NEGOTIATE, THROUGH REAL-TIME STREAMING PROTOCOL (RSTP) FOR SERVER TO SEND AND CP SERVER TO RECEIVE STREAMING MEDIA DATA (FOR EXAMPLE: QUICKTIME STREAMING AUDIO DATA).
CP SERVER RECEIVES STREAMING MEDIA DATA, USING REAL TIME TRANSFER PROTOCOL (RTP), IN STREAMING MEDIA FORMAT NOT THE SAME FORMAT AS STORED ON ORIGINATING SERVER AND CP SERVER STORES THE STREAMING MEDIA DATA, IN THE STREAMING MEDIA FORMAT, ON A STORAGE DEVICE CONTROLLED BY THE CP SERVER.
CP SERVER RECEIVES REQUEST, THROUGH RSTP, FROM A CLIENT FOR THE STREAMING DEDIA DATA AND RETRIEVES THE DATA FROM THE STORAGE DEVICE AND TRANSMITS THE STREAMING MEDIA DATA TO THE CLIENT SYSTEM.

FIG. 1A

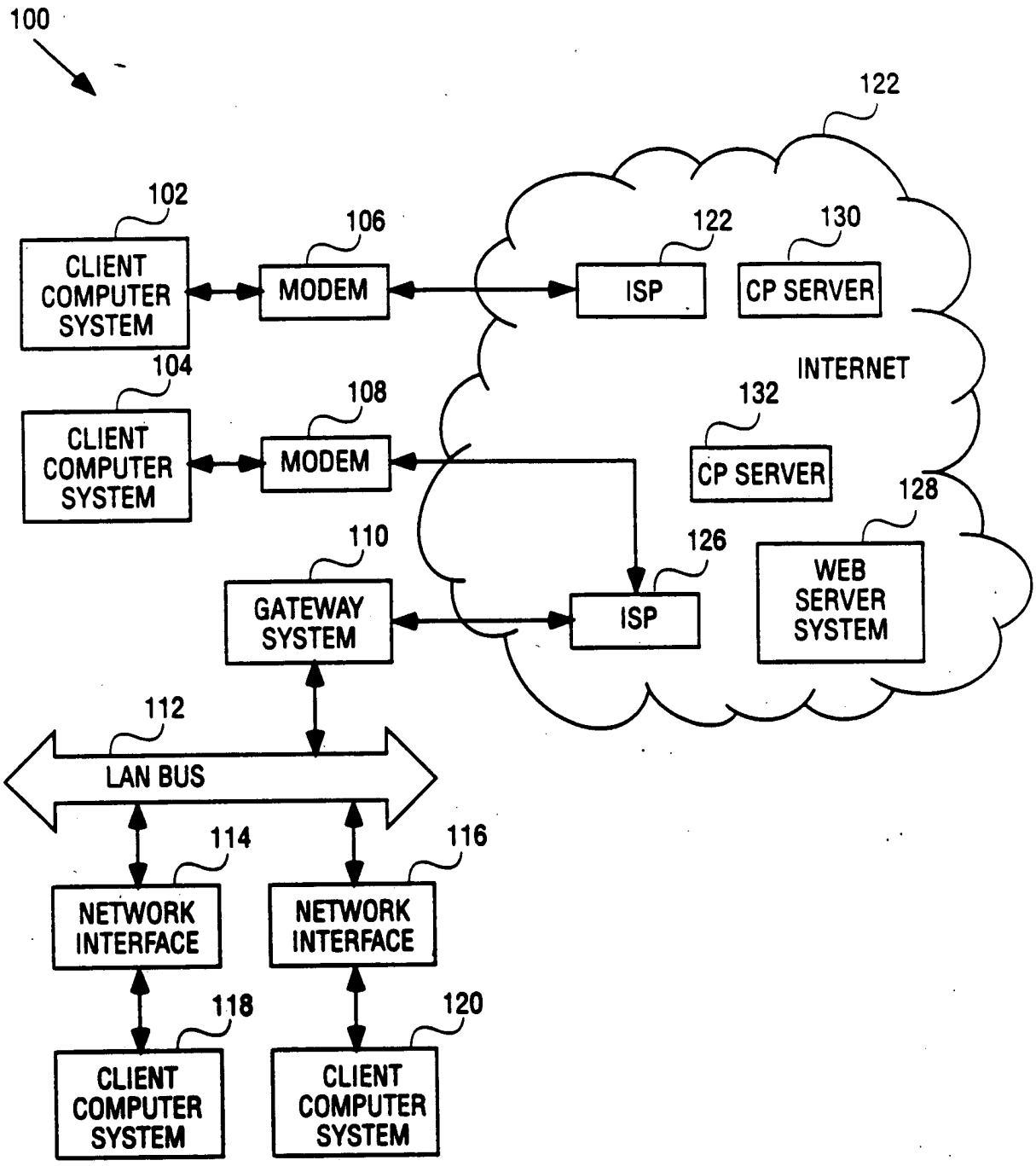
100
122
102
106
122
130
CLIENT COMPUTER SYSTEM
MODEM
ISP
CP SERVER
INTERNET
104
108
132
CLIENT COMPUTER SYSTEM
MODEM
CP SERVER
128
110
126
GATEWAY SYSTEM
ISP
WEB SERVER SYSTEM
112
LAN BUS
114
116
NETWORK INTERFACE
NETWORK INTERFACE
118
120
CLIENT COMPUTER SYSTEM
CLIENT COMPUTER SYSTEM

FIG. 1B

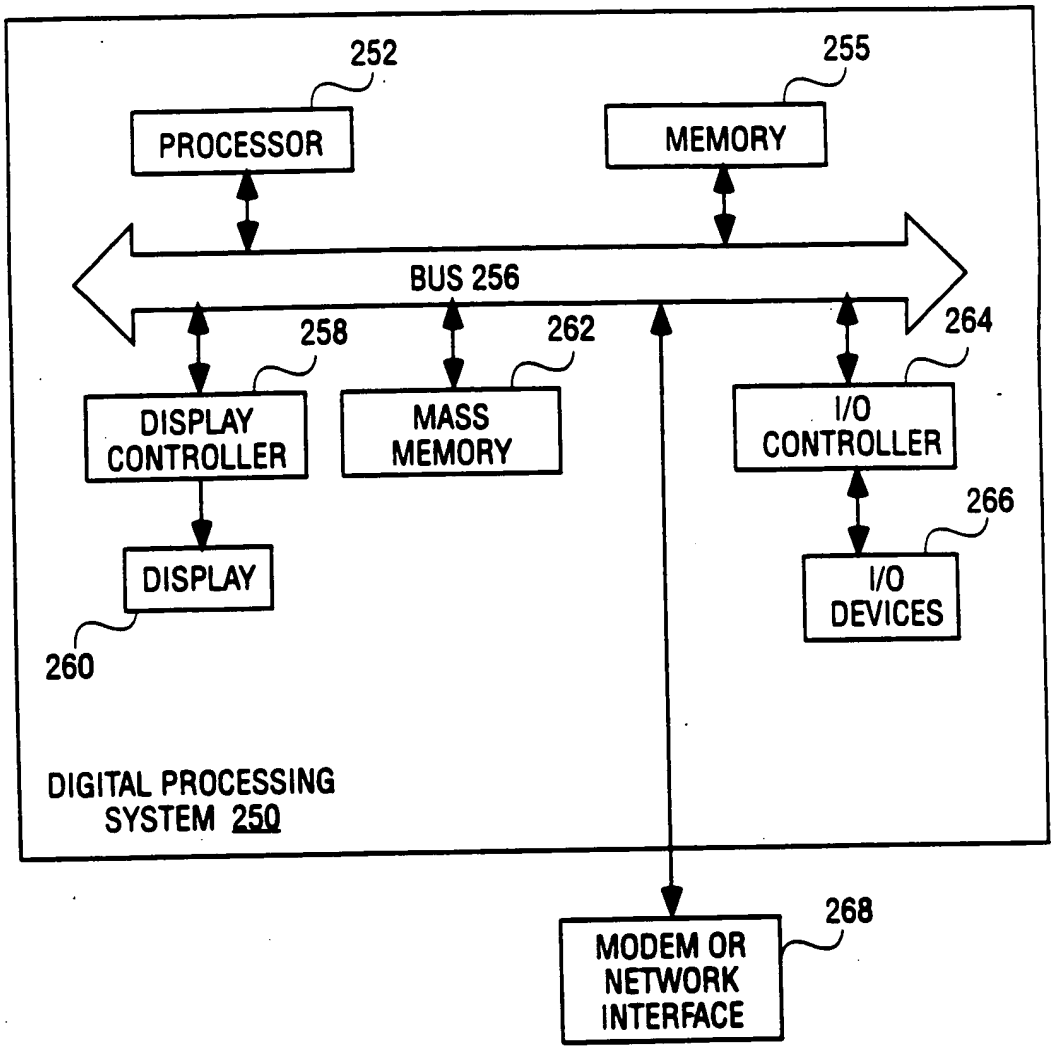
252
PROCESSOR
255
MEMORY
BUS 256
258
DISPLAY CONTROLLER
262
MASS MEMORY
264
I/O CONTROLLER
266
I/O DEVICES
DISPLAY
260
DIGITAL PROCESSING SYSTEM 250
268
MODEM OR NETWORK INTERFACE

FIG. 2

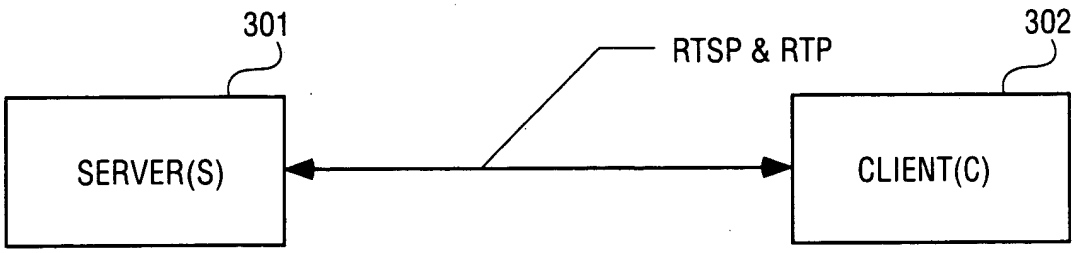
301
RTSP & RTP
302
SERVER(S)
CLIENT(C)

FIG. 3

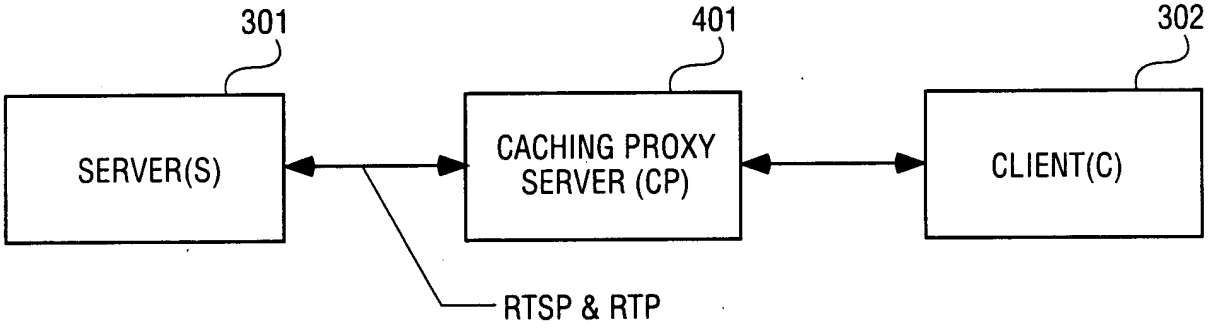
301
401
302
SERVER(S)
CACHING PROXY SERVER (CP)
CLIENT(C)
RTSP & RTP

FIG. 4

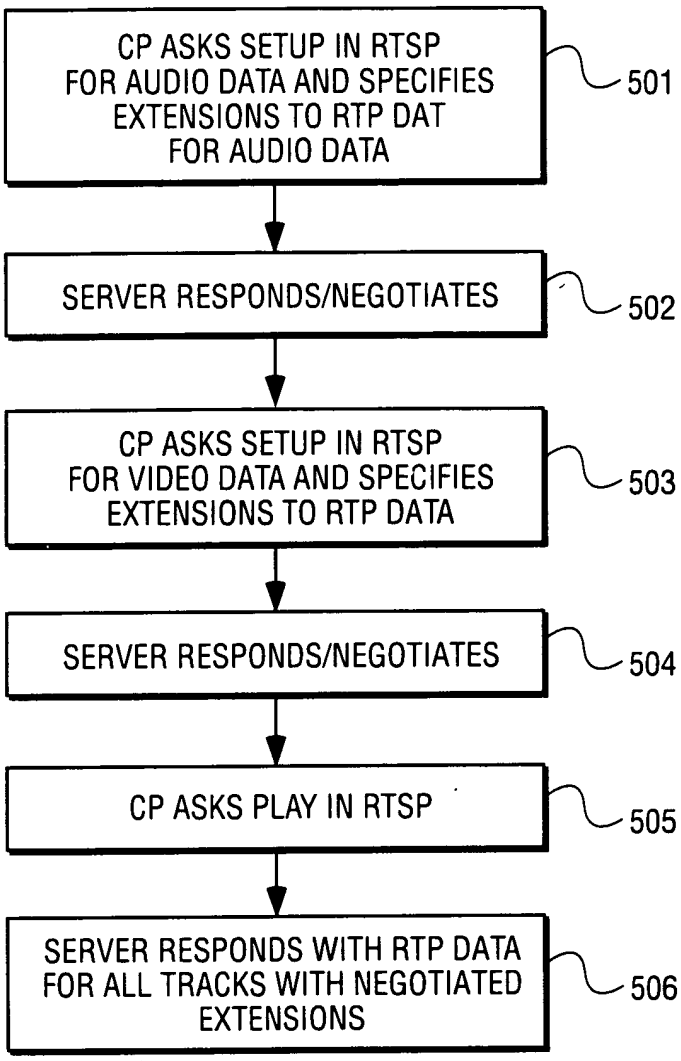
CP ASKS SETUP IN RTSP FOR AUDIO DATA AND SPECIFIES EXTENSIONS TO RTP DAT FOR AUDIO DATA
501
SERVER RESPONDS/NEGOTIATES
502
CP ASKS SETUP IN RTSP FOR VIDEO DATA AND SPECIFIES EXTENSIONS TO RTP DATA
503
SERVER RESPONDS/NEGOTIATES
504
CP ASKS PLAY IN RTSP
505
SERVER RESPONDS WITH RTP DATA FOR ALL TRACKS WITH NEGOTIATED EXTENSIONS
506

FIG. 5

FOREIGN PATENT SEARCH

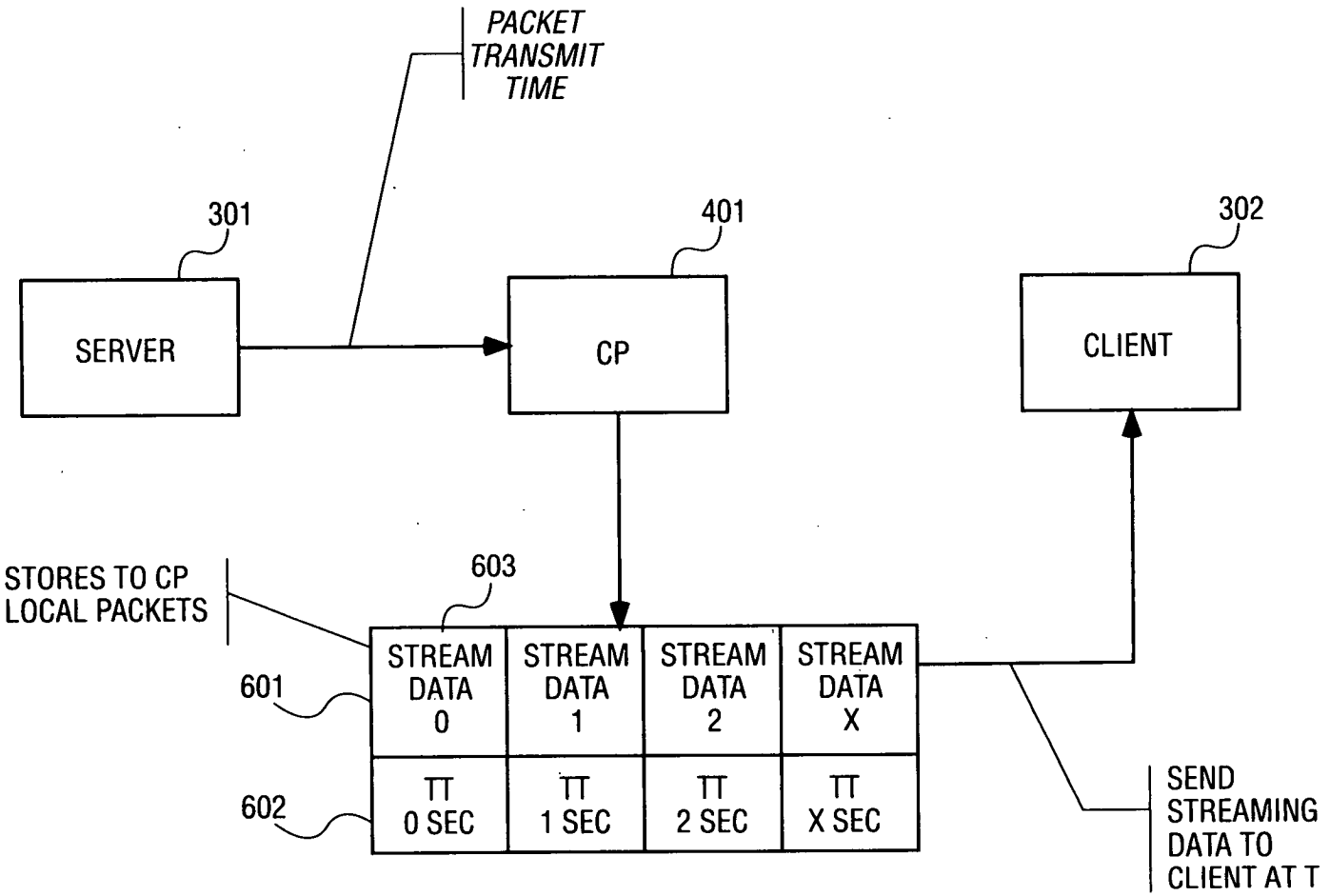

FIG. 6

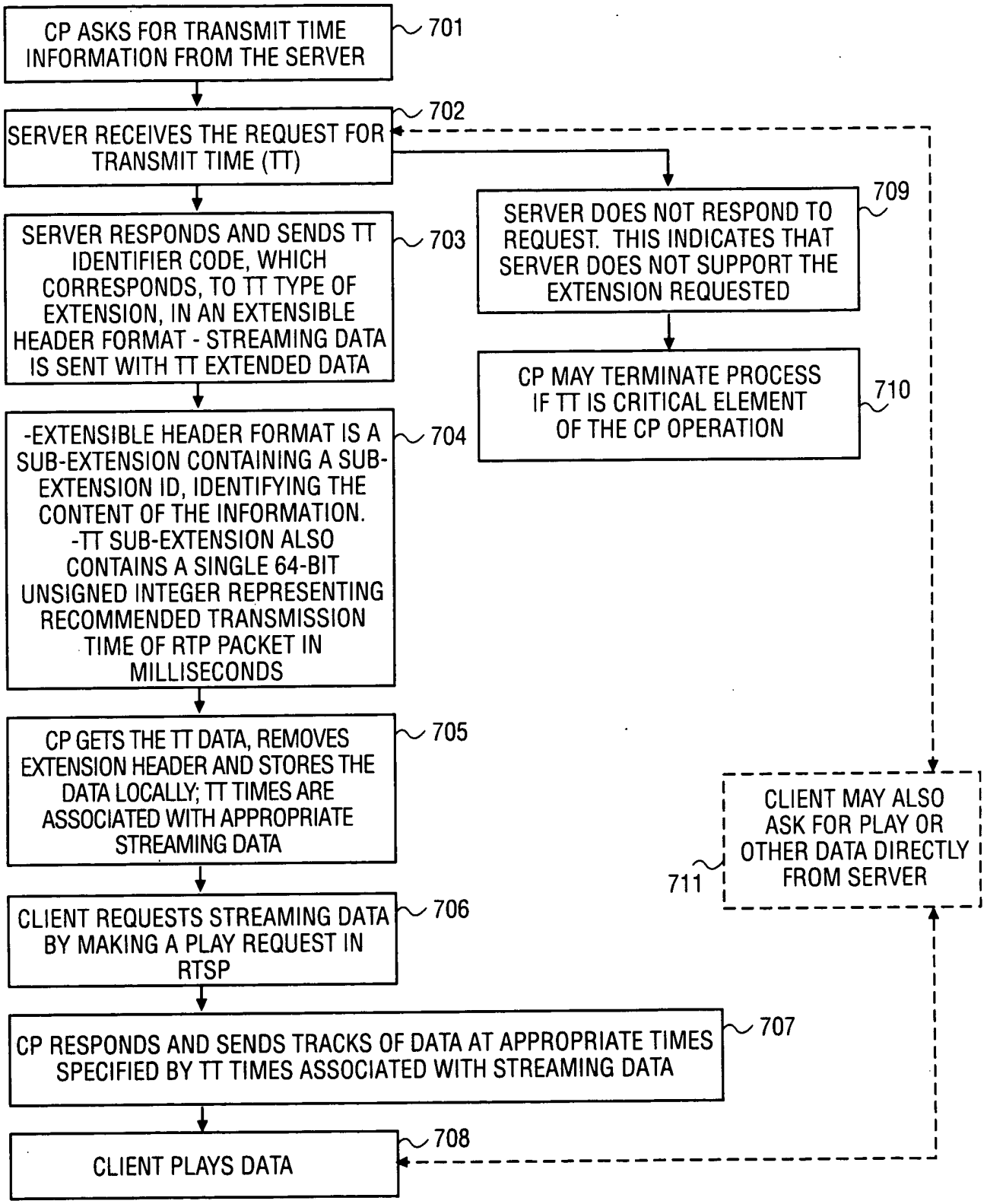
CP ASKS FOR TRANSMIT TIME INFORMATION FROM THE SERVER
701
SERVER RECEIVES THE REQUEST FOR TRANSMIT TIME (TT)
702
SERVER RESPONDS AND SENDS TT IDENTIFIER CODE, WHICH CORRESPONDS, TO TT TYPE OF EXTENSION, IN AN EXTENSIBLE HEADER FORMAT - STREAMING DATA IS SENT WITH TT EXTENDED DATA
703
-EXTENSIBLE HEADER FORMAT IS A SUB-EXTENSION CONTAINING A SUB-EXTENSION ID, IDENTIFYING THE CONTENT OF THE INFORMATION.
-TT SUB-EXTENSION ALSO CONTAINS A SINGLE 64-BIT UNSIGNED INTEGER REPRESENTING RECOMMENDED TRANSMISSION TIME OF RTP PACKET IN MILLISECONDS
704
CP GETS THE TT DATA, REMOVES EXTENSION HEADER AND STORES THE DATA LOCALLY; TT TIMES ARE ASSOCIATED WITH APPROPRIATE STREAMING DATA
705
CLIENT REQUESTS STREAMING DATA BY MAKING A PLAY REQUEST IN RTSP
706
CP RESPONDS AND SENDS TRACKS OF DATA AT APPROPRIATE TIMES SPECIFIED BY TT TIMES ASSOCIATED WITH STREAMING DATA
707
CLIENT PLAYS DATA
708
SERVER DOES NOT RESPOND TO REQUEST. THIS INDICATES THAT SERVER DOES NOT SUPPORT THE EXTENSION REQUESTED
709
CP MAY TERMINATE PROCESS IF TT IS CRITICAL ELEMENT OF THE CP OPERATION
710
CLIENT MAY ALSO ASK FOR PLAY OR OTHER DATA DIRECTLY FROM SERVER
711

FIG. 7

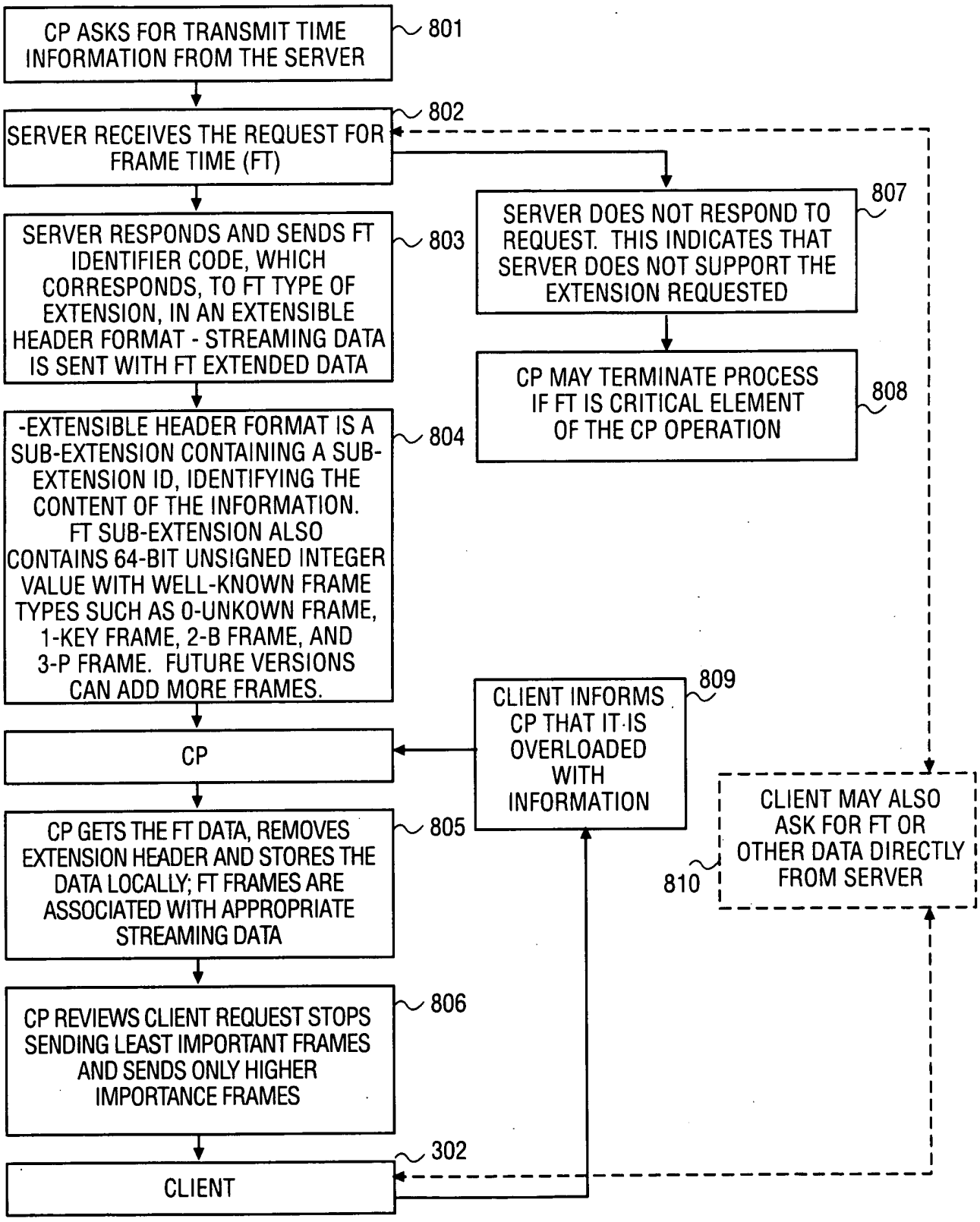
CP ASKS FOR TRANSMIT TIME INFORMATION FROM THE SERVER
801
SERVER RECEIVES THE REQUEST FOR FRAME TIME (FT)
802
SERVER RESPONDS AND SENDS FT IDENTIFIER CODE, WHICH CORRESPONDS, TO FT TYPE OF EXTENSION, IN AN EXTENSIBLE HEADER FORMAT - STREAMING DATA IS SENT WITH FT EXTENDED DATA
803
-EXTENSIBLE HEADER FORMAT IS A SUB-EXTENSION CONTAINING A SUB-EXTENSION ID, IDENTIFYING THE CONTENT OF THE INFORMATION. FT SUB-EXTENSION ALSO CONTAINS 64-BIT UNSIGNED INTEGER VALUE WITH WELL-KNOWN FRAME TYPES SUCH AS 0-UNKOWN FRAME, 1-KEY FRAME, 2-B FRAME, AND 3-P FRAME. FUTURE VERSIONS CAN ADD MORE FRAMES.
804
CP
CP GETS THE FT DATA, REMOVES EXTENSION HEADER AND STORES THE DATA LOCALLY; FT FRAMES ARE ASSOCIATED WITH APPROPRIATE STREAMING DATA
805
CP REVIEWS CLIENT REQUEST STOPS SENDING LEAST IMPORTANT FRAMES AND SENDS ONLY HIGHER IMPORTANCE FRAMES
806
CLIENT
302
SERVER DOES NOT RESPOND TO REQUEST. THIS INDICATES THAT SERVER DOES NOT SUPPORT THE EXTENSION REQUESTED
807
CP MAY TERMINATE PROCESS IF FT IS CRITICAL ELEMENT OF THE CP OPERATION
808
CLIENT INFORMS CP THAT IT IS OVERLOADED WITH INFORMATION
809
CLIENT MAY ALSO ASK FOR FT OR OTHER DATA DIRECTLY FROM SERVER
810

FIG. 8

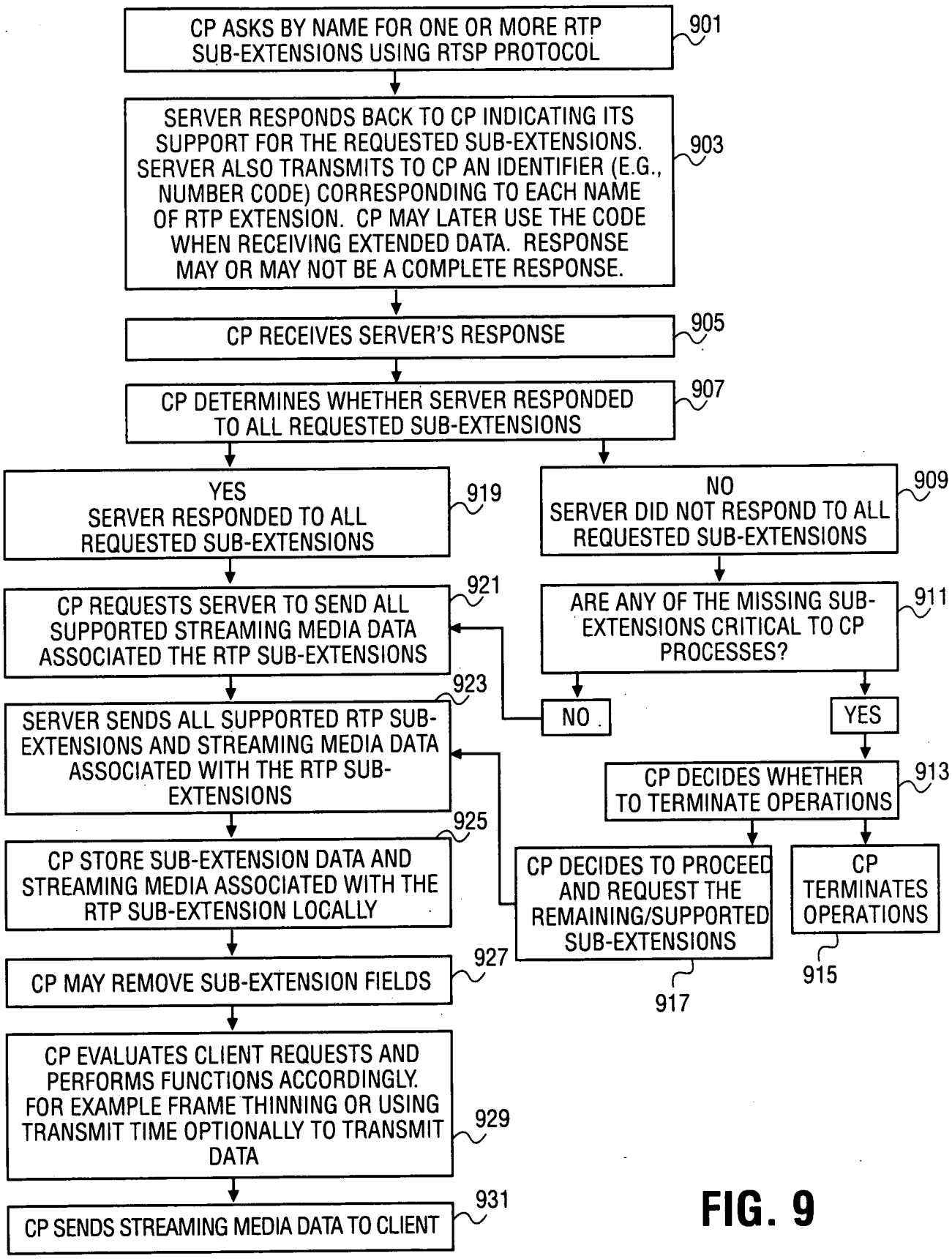
CP ASKS BY NAME FOR ONE OR MORE RTP SUB-EXTENSIONS USING RTSP PROTOCOL
901
SERVER RESPONDS BACK TO CP INDICATING ITS SUPPORT FOR THE REQUESTED SUB-EXTENSIONS. SERVER ALSO TRANSMITS TO CP AN IDENTIFIER (E.G., NUMBER CODE) CORRESPONDING TO EACH NAME OF RTP EXTENSION. CP MAY LATER USE THE CODE WHEN RECEIVING EXTENDED DATA. RESPONSE MAY OR MAY NOT BE A COMPLETE RESPONSE.
903
CP RECEIVES SERVER'S RESPONSE
905
CP DETERMINES WHETHER SERVER RESPONDED TO ALL REQUESTED SUB-EXTENSIONS
907
YES SERVER RESPONDED TO ALL REQUESTED SUB-EXTENSIONS
919
NO SERVER DID NOT RESPOND TO ALL REQUESTED SUB-EXTENSIONS
909
CP REQUESTS SERVER TO SEND ALL SUPPORTED STREAMING MEDIA DATA ASSOCIATED THE RTP SUB-EXTENSIONS
921
ARE ANY OF THE MISSING SUB-EXTENSIONS CRITICAL TO CP PROCESSES?
911
NO
YES
SERVER SENDS ALL SUPPORTED RTP SUB-EXTENSIONS AND STREAMING MEDIA DATA ASSOCIATED WITH THE RTP SUB-EXTENSIONS
923
CP DECIDES WHETHER TO TERMINATE OPERATIONS
913
CP STORE SUB-EXTENSION DATA AND STREAMING MEDIA ASSOCIATED WITH THE RTP SUB-EXTENSION LOCALLY
925
CP DECIDES TO PROCEED AND REQUEST THE REMAINING/SUPPORTED SUB-EXTENSIONS
917
CP TERMINATES OPERATIONS
915
CP MAY REMOVE SUB-EXTENSION FIELDS
927
CP EVALUATES CLIENT REQUESTS AND PERFORMS FUNCTIONS ACCORDINGLY. FOR EXAMPLE FRAME THINNING OR USING TRANSMIT TIME OPTIONALLY TO TRANSMIT DATA
929
CP SENDS STREAMING MEDIA DATA TO CLIENT
931

FIG. 9

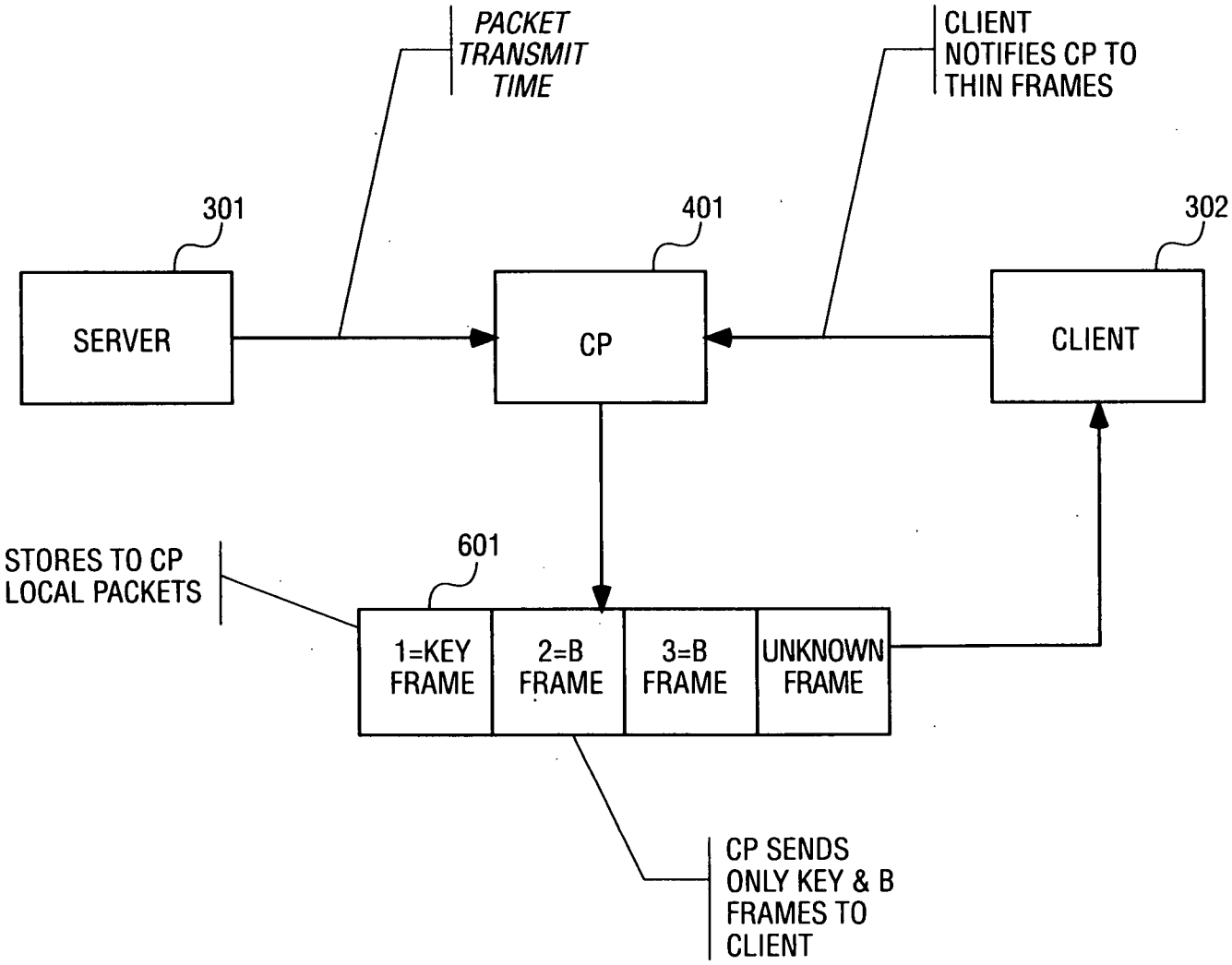
PACKET TRANSMIT TIME
CLIENT NOTIFIES CP TO THIN FRAMES
301
401
302
SERVER
CP
CLIENT
STORES TO CP LOCAL PACKETS
601
1=KEY FRAME
2=B FRAME
3=B FRAME
UNKNOWN FRAME
CP SENDS ONLY KEY & B FRAMES TO CLIENT

FIG. 10

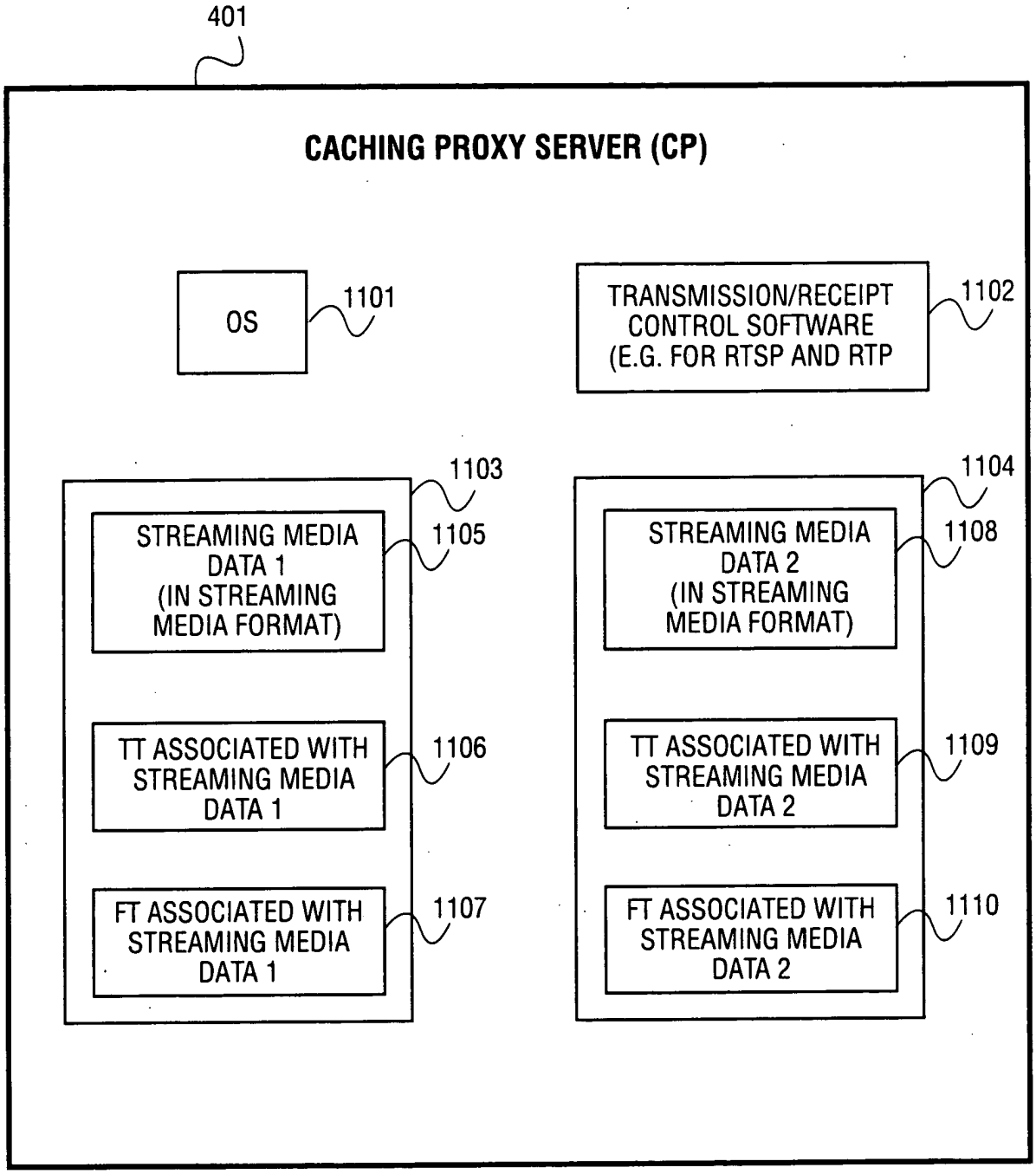
401
CACHING PROXY SERVER (CP)
OS
1101
TRANSMISSION/RECEIPT CONTROL SOFTWARE (E.G. FOR RTSP AND RTP
1102
1103
STREAMING MEDIA DATA 1 (IN STREAMING MEDIA FORMAT)
1105
TT ASSOCIATED WITH STREAMING MEDIA DATA 1
1106
FT ASSOCIATED WITH STREAMING MEDIA DATA 1
1107
1104
STREAMING MEDIA DATA 2 (IN STREAMING MEDIA FORMAT)
1108
TT ASSOCIATED WITH STREAMING MEDIA DATA 2
1109
FT ASSOCIATED WITH STREAMING MEDIA DATA 2
1110

FIG. 11

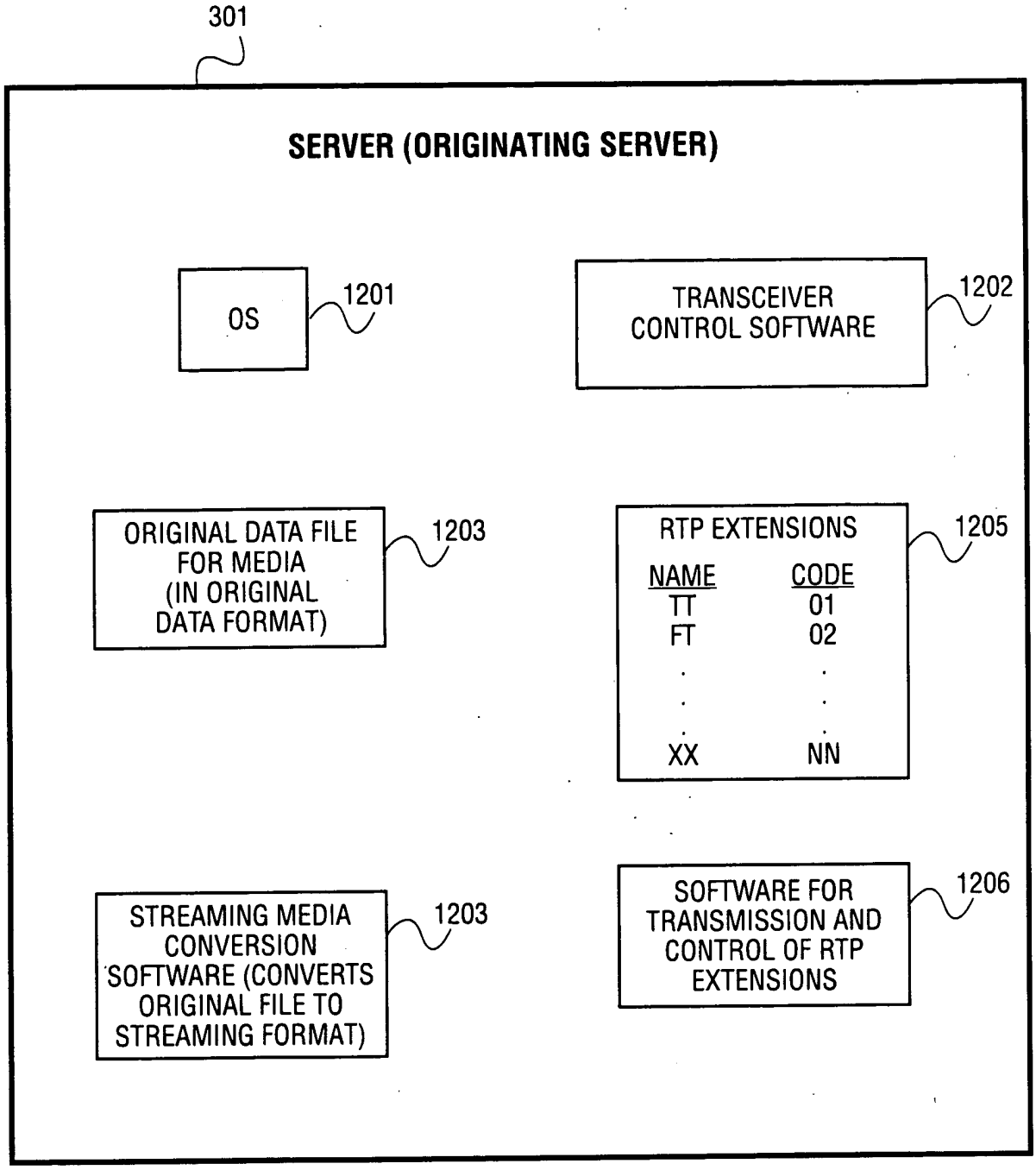
301
SERVER (ORIGINATING SERVER)
OS
1201
TRANSCEIVER CONTROL SOFTWARE
1202
ORIGINAL DATA FILE FOR MEDIA (IN ORIGINAL DATA FORMAT)
1203
RTP EXTENSIONS
NAME CODE
TT 01
FT 02
XX NN
1205
STREAMING MEDIA CONVERSION SOFTWARE (CONVERTS ORIGINAL FILE TO STREAMING FORMAT)
1203
SOFTWARE FOR TRANSMISSION AND CONTROL OF RTP EXTENSIONS
1206

FIG. 12

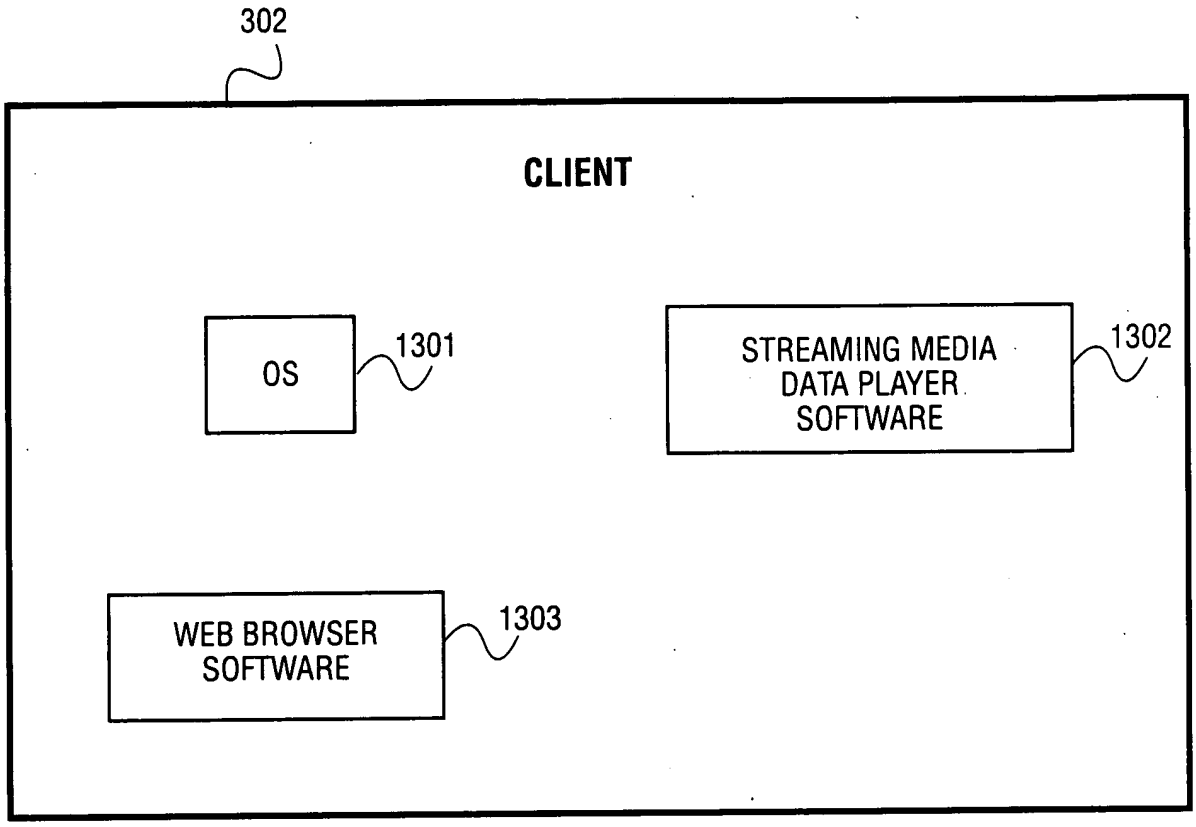
302
CLIENT
OS
1301
STREAMING MEDIA DATA PLAYER SOFTWARE
1302
WEB BROWSER SOFTWARE
1303

FIG. 13

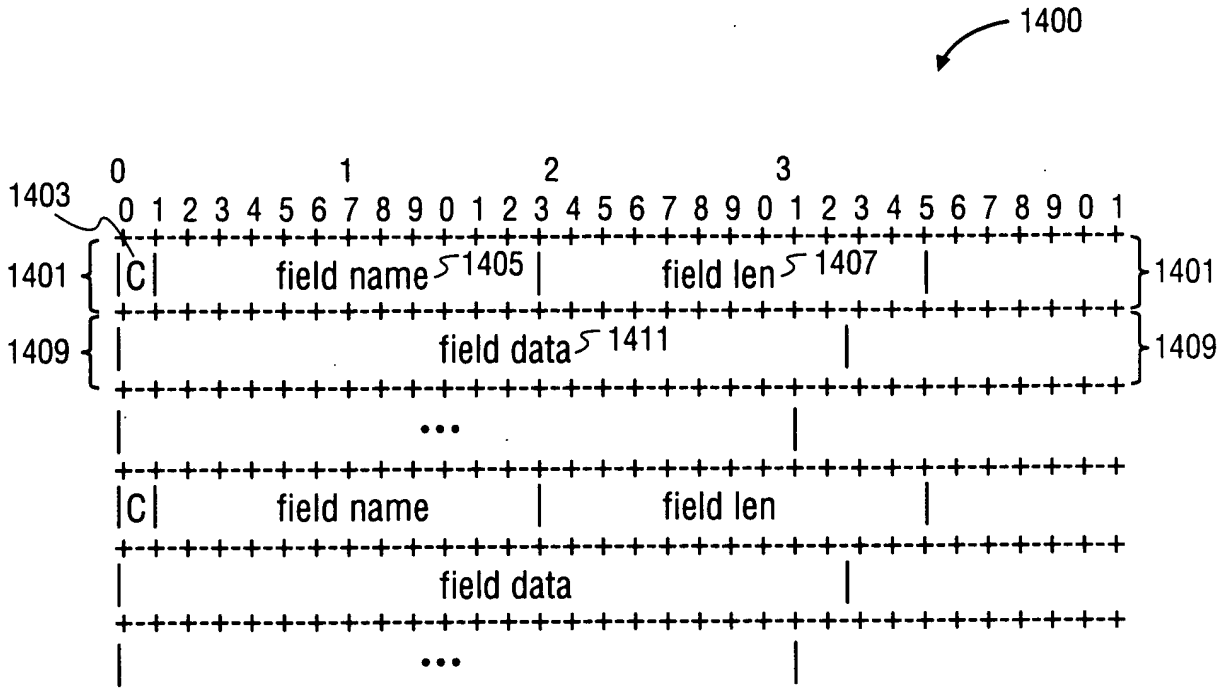
1400
1403
0 1 2 3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
1401
C
field name
1405
field len
1407
1401
1409
field data
1411
1409
C
field name
field len
field data

FIG. 14A

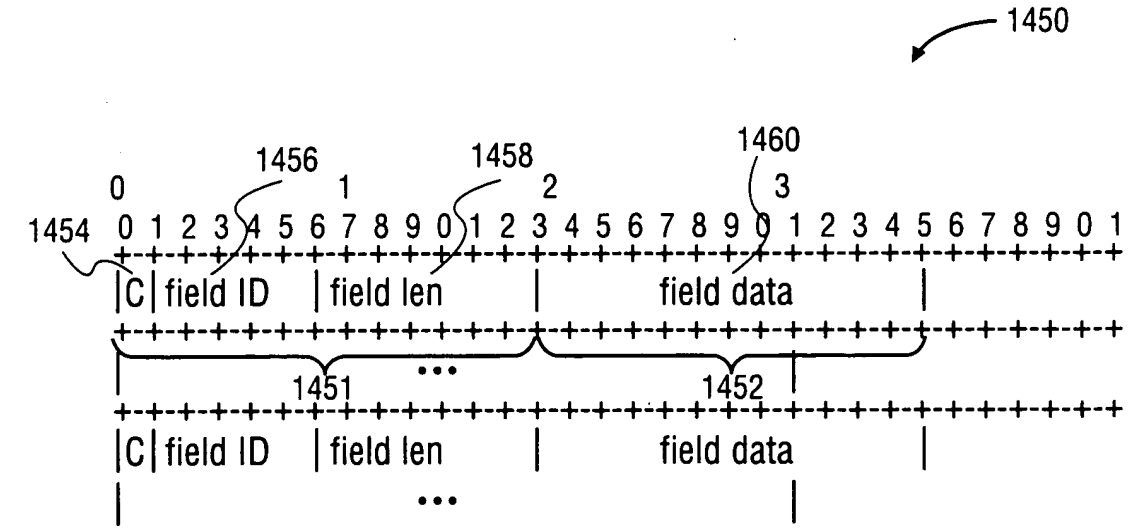

FIG. 14B

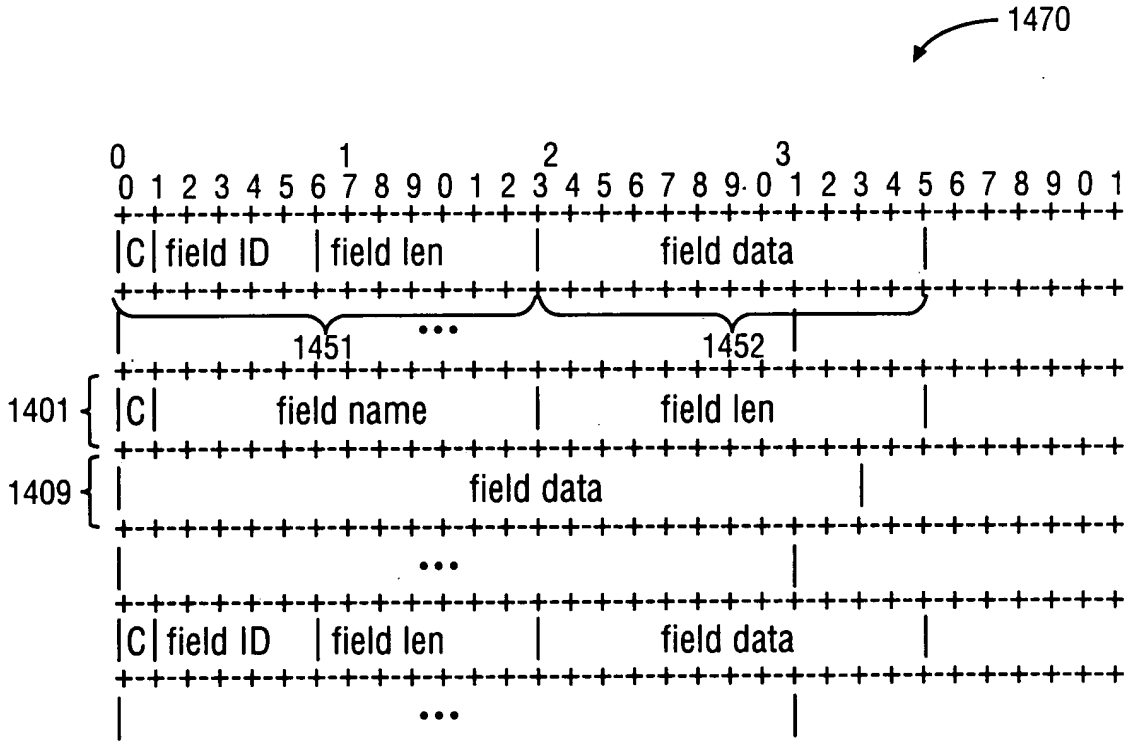

FIG. 14C